



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 12, 2022

Mr. James Barstow
Vice President, Nuclear Regulatory Affairs
and Support Services
Tennessee Valley Authority
1101 Market Street, LP 4A-C
Chattanooga, TN 37402-2801

SUBJECT: WATTS BAR NUCLEAR PLANT, UNIT 2 - ISSUANCE OF AMENDMENT NO. 59
REGARDING REVISION TO STEAM GENERATOR TUBE RUPTURE DOSE
ANALYSIS (EPID L-2021-LLA-0030)

Dear Mr. Barstow:

The U.S. Nuclear Regulatory Commission (Commission) has issued the enclosed Amendment No. 59 to Facility Operating License No. NPF-96 for the Watts Bar Nuclear Plant, Unit 2. This amendment is in response to your application dated March 2, 2021.

The amendment revises the steam generator tube rupture dose analysis in the Watts Bar Nuclear Plant Dual-Unit Updated Final Safety Analysis Report Section 15.5.5 inputs and results for the Unit 2 steam generator tube rupture accident due to the replacement of the Unit 2 steam generators.

A copy of the related safety evaluation is also enclosed. Notice of issuance will be included in the Commission's monthly *Federal Register* notice.

Sincerely,

/RA/

Kimberly J. Green, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-391

Enclosures:

1. Amendment No. 59 to NPF-96
2. Safety Evaluation

cc: Listserv

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ANALYSIS (EPID L-2021-LLA-0030) DATED JANUARY 12, 2021

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ADAMS Accession No.: ML21334A389

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-391

WATTS BAR NUCLEAR PLANT, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 59
License No. NPF-96

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by Tennessee Valley Authority (TVA, the licensee) dated March 2, 2021, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
 - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
 - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
 - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
 - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, by Amendment No. 59, the license is amended to authorize revision to the Updated Final Safety Analysis Report (UFSAR), as set forth in the application dated March 2, 2021. The licensee shall update the UFSAR to revise the Section 15.5.5 dose analysis inputs and results for the Unit 2 steam generator tube rupture accident as described in the licensee's application and the NRC staff's safety evaluation attached to this amendment.
3. This license amendment is effective as of the date of its issuance, and shall be implemented prior to entering Mode 4 during restart following the Watts Bar Unit 2, Refueling 4 outage. The UFSAR changes shall be implemented in the next periodic update to the UFSAR in accordance with 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION

David J. Wrona, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Date of Issuance: January 12, 2022



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO AMENDMENT NO. 59 TO FACILITY OPERATING LICENSE NO. NPF-96
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT, UNIT 2
DOCKET NO. 50-391

1.0 INTRODUCTION

By application dated March 2, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21061A346), the Tennessee Valley Authority (TVA, the licensee), submitted an amendment request to the U.S. Nuclear Regulatory Commission (NRC, the Commission) to revise the Watts Bar Nuclear Plant (Watts Bar) dual-unit Updated Final Safety Analysis Report (UFSAR) for Unit 2. The requested changes would revise the steam generator (SG) tube rupture (SGTR) analysis to utilize the new primary and secondary side mass releases and new reactor coolant system (RCS) and SG masses, associated with the Unit 2 replacement SGs (RSGs).

2.0 REGULATORY EVALUATION

2.1 System Description

Watts Bar, Unit 2, currently has Westinghouse Model D3 SGs. The licensee plans to replace these SGs with Westinghouse Model 68 AXP SGs. As a result of the planned replacement, the licensee reanalyzed the SGTR analysis due to new primary and secondary side mass releases, and new RCS and SG masses associated with the RSGs.

An SGTR results in a loss of primary coolant from the RCS to the secondary side of the affected SG. The event is assumed to take place at full power with the reactor coolant contaminated with fission products based on a conservative assumption regarding a limited amount of defective fuel rods. The flow of radioactive reactor coolant results in contamination of the secondary system. In the event of a coincidental loss of offsite power or failure of the condenser steam dump system, discharge of activity to the environment takes place via the SG power-operated relief valves and safety valves. Operator actions are required to terminate the primary to secondary break flow and the release of steam to the environment. The SGTR analysis is performed to assure that the radiological consequences resulting from an SGTR are within allowable regulatory limits.

2.2 Licensee's Request Changes

The licensee requested NRC approval to modify Section 15.5.5 of the Watts Bar dual-unit UFSAR for Unit 2, only, to revise the SGTR analysis due to the replacement of the Unit 2 SGs. This safety evaluation addresses the impact of the proposed changes on previously analyzed design basis accident (DBA) radiological consequences and the acceptability of the revised analysis results. The changes would update four of the current SGTR physical parameters: primary side mass release from the intact and faulted SGs, secondary side mass release from the intact and faulted SGs, mass of the reactor coolant system, and mass of the secondary side water in the SGs. These changes will be reflected in Table 15.5-18, "Parameters Used in Steam Generator Tube Rupture Analysis." The changes in the SGTR physical parameters affect the SGTR dose consequence analysis. The revised dose consequence analysis values will be updated in Table 15.5-19, "Doses from Steam Generator Tube Rupture." The specific proposed changes are identified in Attachment 1 to the Enclosure to the LAR.

2.3 Regulations and Regulatory Guidance

Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.90, "Application for amendment of license, construction permit, or early site permit," requires that whenever a holder of a license wishes to amend the license, including TSs in the license, an application for amendment must be filed, fully describing the changes desired. Under 10 CFR 50.92(a), determinations on whether to grant an applied-for license amendment are to be guided by the considerations that govern the issuance of initial licenses to the extent applicable and appropriate. Both the common standards for licenses in 10 CFR 50.40(a), and those specifically for issuance of operating licenses in 10 CFR 50.57(a)(3), provide that there must be reasonable assurance that the activities at issue will not endanger the health and safety of the public, and that the activities will be conducted in compliance with the Commission's regulations.

Section 50.59 of 10 CFR permits that a licensee may make changes in the facility as described in its UFSAR, make changes in the procedures as described in its UFSAR, and conduct tests or experiments not described in its UFSAR without obtaining a license amendment pursuant to 10 CFR 50.90 only if: (i) a change to the technical specifications incorporated in the license is not required, and (ii) the change, test, or experiment does not meet any of the criteria in paragraph 10 CFR 50.59(c)(2). Criterion (c)(2)(iii) is "[r]esult in more than a minimal increase in the consequences of an accident previously evaluated in the final safety analysis report (as updated)."

The NRC staff reviewed the licensee's evaluation of the radiological consequences of DBAs against the requirements specified in 10 CFR 100.11, "Determination of exclusion area, low population zone, and population center distance," which requires that the licensee determine:

An exclusion area of such size that an individual located at any point on its boundary for two hours immediately following onset of the postulated fission product release would not receive a total radiation dose to the whole body in excess of 25 rem [roentgen equivalent man] or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

and

A low population zone of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

Watts Bar, Unit 2, was designed to meet the intent of the "Proposed General Design Criteria for Nuclear Power Plant Construction Permits," published in July 1967. The Watts Bar construction permit was issued in January 1973. The UFSAR, however, addresses the General Design Criteria (GDC) published as Appendix A to 10 CFR Part 50 in July 1971. Conformance with the GDCs is described in Section 3.1.2 of the UFSAR (ADAMS Accession No. ML20323A314). The UFSAR indicated no exceptions to the 1971 GDC used by the staff in its review.

General Design Criterion 19, "Control room," in Appendix A, "General Design Criteria (GDC)," to 10 CFR Part 50, stipulates:

A control room shall be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions, including loss-of-coolant accidents. Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident.

The NRC staff considered the following sections of NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-Water Reactor] Edition," during its review:

- SRP Section 6.4, "Control Room Habitability System," Revision 3 (ADAMS Accession No. ML070550069) provides guidance to the NRC staff for evaluating the radiation hazards. It advises that for those plants that do not implement an alternative source term under 10 CFR 50.67, 10 CFR Part 50, Appendix A, GDC 19 requires that "Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident."
- SRP Section 15.6.3, "Radiological Consequences of Steam Generator Tube Failure (PWR) [pressurized-water reactor]," Revision 2 (ADAMS Accession No. ML052350149), provides guidance to the NRC staff for evaluating the radiological consequences of an SGTR. The guidance states that the plant site and the dose mitigating engineered safety features are acceptable with respect to the radiological consequences of a postulated steam generator tube failure accident at a PWR facility if the calculated whole-body and thyroid doses at the exclusion area and the low population zone outer boundaries do not exceed the dose criteria in 10 CFR 100.11.

Regulatory Guide (RG) 1.195, "Methods and Assumptions for Evaluating Radiological Consequences of Design Basis Accidents at Light Water Nuclear Power Reactors," (ADAMS Accession No. ML031490640) provides guidance to licensees of operating power reactors on acceptable methods and assumptions for performing evaluations of fission product releases and radiological consequences of several postulated light-water reactor design basis accidents.

The licensee referenced Watts Bar, Unit 2, Amendment No. 27, "Watts Bar, Units 1 and 2 – Issuance of Amendment Regarding Revision to Watts Bar Unit 2 Technical Specification 4.2.1 Fuel Assemblies, and Watts Bar Units 1 and 2 Technical Specifications Related to Fuel Storage (EPID L-2017-LLA-0427)" (ADAMS Accession No. ML18347B330). This amendment approved the SGTR analysis of record for Watts Bar, Unit 2.

The NRC staff also considered relevant information in the Watts Bar UFSAR (ADAMS Accession No. ML20323A313).

3.0 TECHNICAL EVALUATION

The Nuclear Energy Institute (NEI) has published industry guidance document NEI 96-07, Revision 1, "Guidelines for 10 CFR 50.59 Implementation" (ADAMS Accession No. ML003771157). NEI 96-07, which has been reviewed and endorsed by the NRC staff in Regulatory Guide 1.187 (ADAMS Accession No. ML21109A002), provides guidance to licensees regarding the implementation of 10 CFR 50.59. Section 50.59 of 10 CFR allows licensees to make changes to the licensing basis without prior NRC approval provided that, among other criteria, the increase in consequences of an accident previously evaluated in the UFSAR is no more than minimal. The guidance in NEI 96-07 states that:

An increase in consequences from a proposed activity is defined to be no more than minimal if the increase (1) is less than or equal to 10 percent of the difference between the current calculated dose value and the regulatory guideline value (10 CFR 100 or GDC 19, as applicable), and (2) the increased dose does not exceed the current SRP guideline value for the particular design basis event.

If the increase in dose consequence is determined to be more than minimal then the proposed change is to be submitted to the NRC for review and approval pursuant to 10 CFR 50.90.

Since there is no postulated fuel damage associated with this accident, the main source of radioactivity is the activity in the primary coolant system. The licensee considered two spiking cases: a pre-accident iodine spike and an accident initiated iodine spike.

- a. Pre-accident iodine spike – the initial primary coolant iodine activity is assumed to be 14 microCuries/gram ($\mu\text{Ci/gm}$) of dose equivalent iodine-131 (DEI-131) just prior to the initiation of the accident, which is the Technical Specification (TS) 3.4.16, RCS [reactor coolant system] Specific Activity," limit for full power operation.
- b. Accident initiated iodine spike – the initial primary coolant iodine activity is assumed to be at the maximum TS 3.4.16 limit of 0.265 $\mu\text{Ci/gm}$ DEI-131 (equilibrium TS limit for full power operation). Immediately following the accident, the iodine appearance rate from the fuel to the primary coolant is assumed to increase to 500 times the equilibrium appearance rate corresponding to the 0.265 $\mu\text{Ci/gm}$ DEI-131 coolant concentration. The duration of the assumed spike is 8 hours (see UFSAR Table 15.5-18, ADAMS Accession No. ML20323A316).

The licensee's revised calculated accident dose consequence analyses for the RSGs showed that the thyroid dose in the main control room for the pre-accident iodine spike case exceeds the NEI 96-07 criterion of a greater than a 10 percent increase (see LAR Table 2). Of the 18

updated SGTR DBA calculations, 16 of the remaining calculated values decreased for the RSGs, and one value increased by less than 10 percent.

The NRC staff reviewed the regulatory and technical analyses, as related to the radiological consequences of the SGTR accident performed by TVA in support of its proposed license amendment. The NRC staff reviewed the assumptions, inputs, and methods used by TVA to assess the impacts of the increased RCS and SG volumes on the SGTR accident. The findings of this safety evaluation are based on the descriptions of changes described in the LAR and included review of the results of the licensee's analyses, and information previously submitted in TVA's letter to NRC, "Application to Revise Watts Bar Unit 2 Technical Specification 4.2.1, 'Fuel Assemblies,' and Watts Bar Units 1 and 2 Technical Specifications Related to Fuel Storage (WBN-TS-17-028)," dated December 20, 2017 (ADAMS Accession No. ML17354B282) and supplemental response to additional information dated October 4, 2018 (ADAMS Accession No. ML18283A107). The licensee noted that in the December 20, 2017, LAR submittal, the initial condition "Mass of Reactor coolant" had two numbers transposed. This error had a negligible effect on the previous accident dose consequence analysis and was corrected in this accident dose consequence analysis for the RSGs presented in the current LAR.

The licensee evaluated the impact of the RSGs on the radiological consequences of the SGTR accident analyses. With the RSGs, the following inputs changed: (1) primary side mass release, (2) secondary side mass release, (3) mass of the reactor coolant system, and (4) mass of the secondary side water in the SGs. The licensee previously provided all initial conditions for the SGTR accident in Tables 4.1-4, 4.1-5, 4.1-6, 4.1-7, and 4.1-16 of LAR dated December 20, 2017 referenced above. The NRC staff previously found these values acceptable for the reasons presented in the safety evaluation supporting Watts Bar, Unit 2, Amendment No. 27, issued on May 22, 2019 (ADAMS Accession No. ML18347B330). All other inputs and assumptions remained unchanged. The licensee determined that only the main control room thyroid dose for the Pre-Accident Iodine Spike (14 $\mu\text{Ci/gm}$ maximum peak) case and the Accident Initiated Iodine Spike (0.265 $\mu\text{Ci/gm}$ steady state) case would increase with the RSGs. However, only the Pre-Accident Iodine Spike calculated thyroid dose in the main control room exceeded the 10 percent increase criterion of NEI 96-07. This value increased from 13.1 rem to 15.1 rem (approximately 15 percent increase) and is approximately 50 percent of the 30 rem current licensing basis dose limit for the main control room.

The licensee used previously generated main control room, exclusion area boundary (EAB), and low population zone (LPZ), atmospheric dispersion factors (χ/Q values) to evaluate the radiological consequences of the SGTR dose assessment described above. These χ/Q values were previously submitted by the licensee as part of a license amendment request related to tritium production that included a SGTR dose assessment, "Application to Revise Watts Bar Unit 2 Technical Specification 4.2.1, 'Fuel Assemblies,' and Watts Bar Units 1 and 2 Technical Specifications Related to Fuel Storage (WBN-TS-17-028)," dated December 20, 2017, as supplemented February 15, April 9, and October 4, 2018. The NRC staff previously found these χ/Q values acceptable for the reasons presented in the safety evaluation supporting the Watts Bar, Unit 2, Amendment No. 27.

The NRC staff performed independent calculations to confirm the conclusions reached by the licensee for the SGTR accident for the RSGs. The NRC staff's independent calculations confirmed the licensee's analysis that only the Pre-Accident Iodine Spike thyroid dose in the main control room would exceed the 10 percent increase criterion of NEI 96-07, and all values remain below regulatory limits. The tables below list the licensee's results from the SGTR analyses for the RSGs.

Pre-Accident Initiated Iodine Spike (14 $\mu\text{Ci/gm}$ maximum peak)

(rem)	EAB WBN Unit 2 (2-hour dose)	EAB Limit	LPZ WBN Unit 2 (duration of event)	LPZ Limit	Main Control Room WBN Unit 2 (30-day dose)	Control Room Limit
Whole Body	3.58×10^{-1}	25	1.04×10^{-1}	25	5.19×10^{-2}	5
Beta	1.92×10^{-1}	300	5.78×10^{-2}	300	5.65×10^{-1}	30
Thyroid	1.36×10^1	300	3.88	300	1.51×10^1	30

Accident Initiated Iodine Spike (0.265 $\mu\text{Ci/gm}$ steady state)

(rem)	EAB WBN Unit 2 (2-hour dose)	EAB Limit	LPZ WBN Unit 2 (duration of event)	LPZ Limit	Control Room WBN Unit 2 (30-day dose)	Control Room Limit
Whole Body	5.36×10^{-1}	2.5	1.55×10^{-1}	2.5	4.85×10^{-2}	5
Beta	2.28×10^{-1}	300	6.84×10^{-2}	300	5.49×10^{-1}	30
Thyroid	7.00	30	2.03	30	2.58	30

As described above, the staff evaluated the radiological impact of the RSGs and the proposed licensing basis changes on the postulated design basis SGTR. The staff finds with reasonable assurance that the proposed changes to the SGTR accident analyses, as described in the LAR, are acceptable and the licensee will continue to meet the applicable dose acceptance criteria, as identified in Section 2.0 of this safety evaluation, following implementation of these proposed changes. Therefore, the staff concludes that the proposed license amendment is acceptable with respect to the radiological dose consequences of the SGTR DBA.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Tennessee State official was notified of the proposed issuance of the amendment on August 3, 2021. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission previously issued a proposed finding that the amendment involves no significant hazards consideration in the *Federal Register* on April 20, 2021 (86 FR 20532), and there has been no public comment on such finding. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: S. Meighan, NRR

Date: January 12, 2022